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ABSTRACT

The purpose of this project is to help elementary school teachers get started using the computer to aid the teaching and learning of many scientific concepts in a meaningful way. The authors have developed their own software package, "Elementary Science Activities," and have selected several commercially available software packages that are versatile, cost effective, and easy to use. This report includes reviews/descriptions and several activities for these programs. The teacher-developed software contains a "Rock Identification Key"; a "Needle Trees Key"; and "The Solar System." There are program reviews/descriptions for the commercial software "The Factory," and "The Pond"; and reviews/descriptions and activities for "The Incredible Laboratory," "MECC Graph," and "Science Tool Kit, Master Module." The format of these programs pairs readily available manipulatives with computer programs to develop logical thinking skills as they query and guide the student through the activities. The programs were selected to aid the development of logical thinking, pattern recognition, sequencing, and organization. They are self-testing and correcting, and help to promote self-motivation by incorporating fun, graphics, and sound into the lessons. (YP)

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PROJECT TO INCREASE MASTERY OF MATHEMATICS AND SCIENCE

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# Microcomputer Activities for the Teaching of Science and Thinking Skills in The Elementary School Grades 3-7

A Curriculum Development Project
of the
Project to Increase Mastery of Mathematics and Science

**APRIL 1988**

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# Microcomputer Activities for the Teaching of Science and Thinking Skills in The Elementary School Grades 3-7

A Curriculum Development Project
of the
Project to Increase Mastery of Mathematics and Science

Prepared by

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APRIL 1988

## HISTORY, GOALS, AND SUPPORT OF pimms

The Project to Increase Mastery of Mathematics (**pimm**) began in 1979 as a joint effort of a diverse group of volunteers -- individuals from education, business, government, industry, and labor -- to foster greater command, understanding, and appreciation of mathematics by graduates of Connecticut schools. The symbiotic relationship of mathematics and its applications was a pervasive theme of the various **pimm** undertakings.

In 1983, the organization broadened its scope to become the Project to Increase Mastery of Mathematics and Science (**pimms**), and at the same time expanded its activities by mounting a Fellowship Program: notably able Connecticut high school teachers of mathematics and science were invited to study together at Wesleyan in courses and seminars as a prelude to offering consultative assistance on curricular matters to schools requesting such service and to providing workshops to teachers for their professional development.

Several groups of Fellows are devoting the bulk of their energies to writing projects. The materials they prepare will be broadly disseminated to facilitate the introduction into school curricula of mathematical applications of major importance and considerable attractiveness.

Now several Fellowship Programs are in operation, extending the concept to middle school and elementary school teachers. A significant value of the Fellowship Programs is found in the colleagueship developed among professionals working in different institutions at varied levels.

Throughout its growth, **pimms** has continued as a partnership of individuals and organizations. The list of devoted volunteers is too long to be recorded here. Major financial support of **pimms** has been supplied by the Connecticut Department of Education, the Connecticut Department of Higher Education, the Charles E. Culpeper Foundation, the General Electric Foundation, GTE, Divisions of United Technologies Corporation (Hamilton Standard, Norden Systems, Otis Elevator, Pratt and Whitney Manufacturing, Research Center, Sikorsky Aircraft), and Wesleyan University. Substantial contributions have also been made by Amax Foundation, Army Research Office, Boehringer Ingelheim, Chesebrough-Ponds, Choate Rosemary Hall, CIGNA, Connecticut Academy of Science and Engineering, General Signal, the Edward W. Hazen Foundation, Northeast Utilities, Omega Group, The Perkin-Elmer Corporation, Pfizer Inc., Pitney Bowes, Raymond Engineering, SNET, Stanley Works, Union Carbide Corporation, and Xerox Corporation.

All of us who are concerned for high quality education owe a great debt of gratitude to these organizations for their corporate citizenship.

R. A. Rosenbaum
Director, **pimms**

## FOREWORD

In the report, How Schools Use Microcomputers, Henry Jay Becker stated,

> "... with an organized and sustained strategy for using computers to improve the effectiveness of school instruction we might accomplish what has eluded education throughout recent decades -- clear and obvious improvements in student accomplishment and in how much learning occurs in a day in school. Nothing would help the institution or its practitioners more." *

The purpose of this Curriculum Development Project is to help bring the technological capabilities of the microcomputer into the K - 7 classroom in the area of problem-solving. This volume is a step towards the realization of that goal, and subsequent volumes will broaden the scope of suggested activities.

Connecticut school districts may contact the **pimms** office for information on scheduling a Computer Software Awareness Workshop or other in-service program related to the use of computers for elementary school mathematics or science instruction.

We earnestly solicit the comments of users of this material. Please send your suggestions for improvements, reviews, or lessons to

Robert W. Shackleton
Science Coordinator, **pimms**
Butterfield A/ Suite 110
Wesleyan University
Middletown, CT 06457



*Becker, Henry Jay. How Schools Use Microcomputers: Summary of the 1983 National Survey, The Johns Hopkins University Center of Social Organization of Schools; Baltimore, 1985.

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## INTRODUCTION

In the late '70s and early '80s the microcomputer burst upon the scene of public education. School districts purchased the hardware and used the equipment mainly to teach various programming languages. While the potential power of this new technology was recognized, very few school systems developed programs to incorporate the use of the computer as an instructional tool. Now, after nearly a decade of undergoing a natural winnowing process, much high quality commercial software is available to teachers of all subjects at all grade levels. Current software focuses on problem solving and the development of thinking skills in conjunction with the topical content presented.

The purpose of this project is to help elementary school teachers get started using the computer to aid the teaching and learning of many scientific concepts **in a meaningful way**. To this end, the writing team has developed its own software package (**Elementary Science Activities**) and has selected several commercially available software packages which are versatile, cost effective, and easy to use. A review/description and several activities are included for each package/program and are presented in ready-to-use form. The lesson material may be photocopied for classroom use.

The teacher-developed software incorporated here was designed by the writers of this volume. The master disk is entitled **Elementary Science Activities** and the programs contained in the package (*i.e.*, on the disk) are *Rock Identification Key*, *Needle Tree Key*, and five programs relating to the solar system. The format of these programs pairs readily-available manipulatives (rocks, tree needles, planet models) with computer programs which develop logical thinking skills as they query and guide the student through the activities. [The **Elementary Science Activities** (ESA) disk is issued as take-away software to participants in ESA Workshops (see inside back cover).]

The commercial software programs/packages selected are among those which best serve the development of thinking/problem solving skills. Among the skills introduced and reinforced are logical thinking, pattern recognition, sequencing, and organization. Each program presents a challenge for students at all levels, is self-testing and correcting, and may be run for one or more students. These programs promote self-motivation by incorporating fun, graphics, and sound.

The Microcomputer-Based Laboratory (MBL) package (Science Toolkit) incorporates the actual use of instruments (probes) to detect and measure physical quantities such as heat and light intensity which are then recorded, organized, and displayed by the software program. Student involvement centers upon data gathering, observation, prediction, and the interpretation of program-generated output (graphs, tables, computed values, etc.).

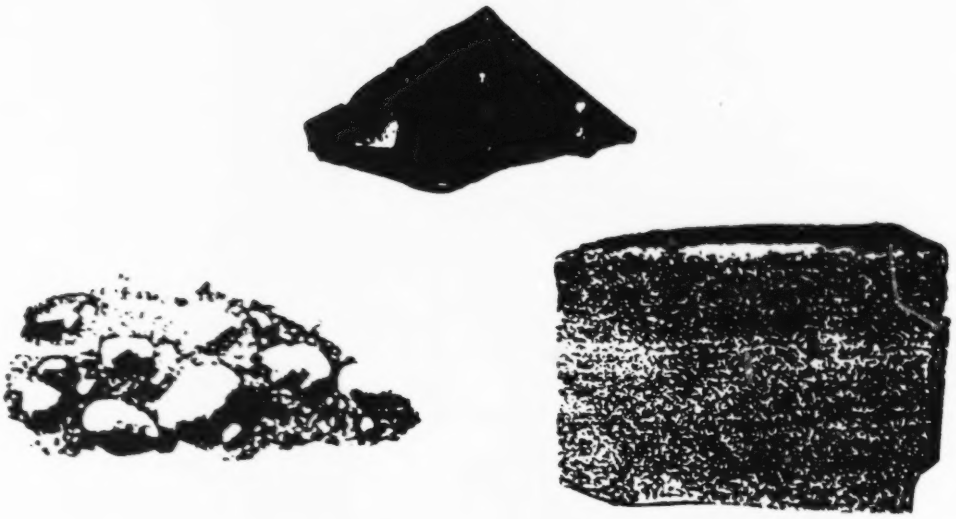
The activities presented in this volume can be used as class-size activities, small group activities, or individual projects. They are designed to promote interaction between the teacher and the students and among the students. Contrary to popular belief, this type of activity does not increase the time needed to teach the concepts but improves efficiency and effectiveness by promoting the understanding of a problem, the ability to visualize and verbalize the problem, and the interpretation of results of investigations.

We hope that this first volume will help to spark the imagination of creative teachers who will then begin to develop their own lessons. Although all of the software reviewed herein relates to the Apple II and Commodore 64 microcomputers, some of the packages may be available for other computers. Users are advised to check software catalogs for such availability. As more instructional software becomes available for the Macintosh and IBM micro-computers, reviews and lessons for them will be included in future volumes of this publication.

The writers wish to thank Paul Bengtson, Micro Turn-Ons, Inc., Weston, for his assistance with programming. Also, we thank Prof. Ralph Yulo of Eastern Connecticut State University for his inspiration and encouragement in the development of hands-on activities.

**To assure that your intended use does not violate copyright regulations, you are advised to read carefully the restrictions on use of commercial software. Many software packages are available in 10-disk sets or via a site-license agreement so that classroom sets of diskettes can be purchased at a reasonable price.**

**Computer Software Program Review and Description**



Program: ***Rock Identification Key***
Package: **Elementary Science Activities**
Package developers: Eileen Bengtson, Sandy Justin, Paulette Malay
Programmers: Paulette Malay, Paul Bengtson
Computers: Apple IIe, Commodore 64
Grade Levels: 3-7
Skills developed: observation, deductive reasoning
Prerequisite skills/concepts: knowledge of the terminology and the geologic processes involved in rock identification

Description: This rock identification program is designed to help students identify certain metamorphic, sedimentary, and igneous rock samples via hands-on activities and observation. The program offers neither an introduction nor a complete unit on rock identification.

It is not necessary to have every sample on hand. It would not be appropriate to include rocks which cannot be identified through this program because this would lead to confusion and frustration on the part of the student. Applications and/or Extension Activities may be utilized as additional classroom or homework activities.

## Computer Software Activity Lesson Plan

Topic: Name that Rock

Objectives:

The student will be able to identify as many as 12 samples from the 3 rock groups via their physical characteristics.

Software needed: master disk - **Elementary Science Activities**
program - ***Rock Identification Key***

Other materials:

samples of
***igneous rocks***: granite, pumice, basalt, obsidian
***sedimentary rocks***: conglomerate, sandstone, shale, limestone
***metamorphic rocks***: schist, gneiss, slate, marble
water/container
vinegar/container
hand lens (optional)
Data Sheets
Applications Sheets
Extension Sheets (?)

General Description of the Activity/Procedure:

1. Obtain 2 or 3 samples of each rock type.
2. Run *Rock Identification Key* program.
3. Identify samples via the program.
4. Complete Applications Worksheets.

**Name that Rock**
***Data Sheet***

List the rocks you identified along with a characteristic of each rock.

A. Igneous

| | |
|---|---|
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

B. Sedimentary

| | |
|---|---|
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

C. Metamorphic

| | |
|---|---|
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

**Name that Rock**
***Applications Worksheet***

## Igneous--Volcano

1. How were igneous rocks formed?

2. How do large particles form? Small particles?

3. Name these rocks by particle size:

holes--air bubbles inside _____

fine--cools slowly _____

large--cools the slowest _____

glassy--cools very quickly _____

## Sedimentary:

1. How do the rock particles get to the ocean?

2. Why are the rock particles larger close to the shore?

3. Name the rock that is formed from these particles:

gravel _____

sand _____

silt _____

lime _____

**Name that Rock**

***Applications Worksheet***

(cont'd)

## Metamorphic:

1. What does the word metamorphic mean?

2. There are two forces that change rock. What are they?

3. Where does the pressure come from to change rock?

4. Where does the heat come from to change rock?

5. Name the rock(s) formed from these:

   conglomerate _____ and _____

   shale _____

   limestone _____

Things To Do:

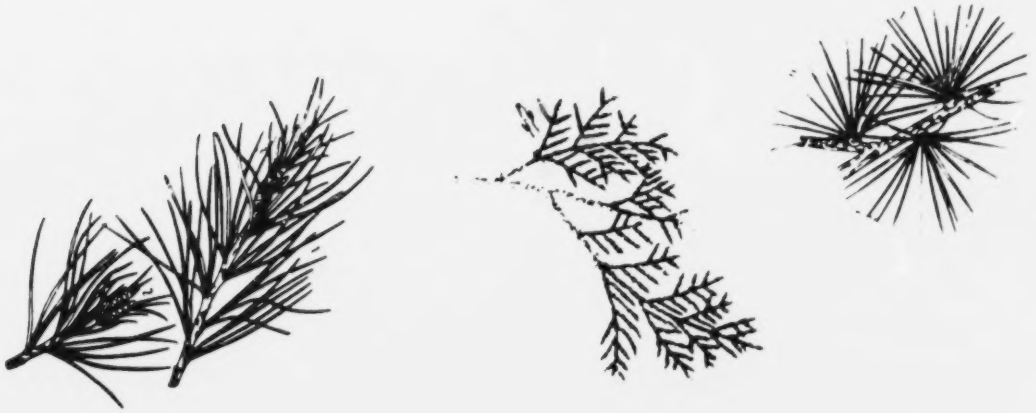
1. Pretend you are a rock. How were you born? What do you look like? Where do you live? What do you do for fun? What do you think about? Have you ever met a human? Do you have any friends? What else can you share about yourself?

2. What is your favorite rock group? Why?

3. Make a rock sculpture, a pet rock, a rock concert, or . . .

4. Find a rock you like. Describe, in detail, information about its size, shape, color, weight, history, or anything else that is interesting.

**Computer Software Program Review and Description**



Program: ***Needle Tree Key***
Package: **Elementary Science Activities**
Developed by: Eileen Bengtson, Sandy Justin, Paulette Malay
Programmed by: Paulette Malay
Computers: Apple IIe, Commodore 64
Grade Levels: 3-7
Skills developed: observation, identification, measurement

Description: The program *Needle Trees* is based on a keying system for conifer identification and leads to the identification of twelve different trees based on their needles: LARCH, WHITE CEDAR, RED CEDAR, WHITE PINE, PITCH PINE, AUSTRIAN PINE, JACK PINE, NORWAY PINE, SCOTCH PINE, HEMLOCK, FIR, AND SPRUCE.

This is a "hands-on" activity wherein the student uses actual specimens taken from any or all of the trees listed above. [We suggest a minimum of four or five specimens for each group of students. The specimens should be marked with an identifying code to enable the teacher to monitor which sample the student is identifying,.]

Groups of students each are assigned a bag of specimens and a computer with the Needle Trees program ready to go. The group selects one of the specimens and runs the program - which will ask questions about the specimen and eventually give its identity. The process involves observing and measuring and recording observations on a data sheet. For students who think every needle tree is a "pine tree", this program will help broaden their knowledge about needle tree identification.

## Computer Software Activity Lesson Plan

Topic: Name that Tree

Objectives:

The student will be able to identify up to 12 species of needle trees via their physical characteristics.

Software needed: master disk - **Elementary Science Activities**
program - ***Needle Tree Key***

Other materials:

needle tree branches from the following list (enough for each group to have samples):

larch, white cedar, red cedar, white pine, pitch pine, jack pine, scotch pine, Austrian pine, Norway pine, spruce, fir, hemlock

Data Sheets
Extension Activities sheets

General Description of the Activity/Procedure:

1. Obtain samples of needle trees.
2. Number the samples 1,2,3, ...
3. Break your class into groups and distribute the samples.
4. Run *Needle Tree Key* program.
5. Identify samples.
6. Complete Data Sheet.
7. Select Extension Activities.

**Name that Tree**
*Data Sheet*

We think #1 is a _____ because it has _____

_____

We think #2 is a _____ because it has _____

_____

We think #3 is a _____ because it has _____

_____

We think #4 is a _____ because it has _____

_____

We think #5 is a _____ because it has _____

_____

We think #6 is a _____ because it has _____

_____

We think #7 is a _____ because it has _____

_____

We think #8 is a _____ because it has _____

_____

We think #9 is a _____ because it has _____

_____

**Name that Tree**

***Data Sheet***, continued

We think # 10 is a _____ because it has _____

_____

We think # 11 is a _____ because it has _____

_____

We think # 12 is a _____ because it has _____

_____

From your observations:

1. What general characteristics are common to pine trees?

_____

_____

2. What are the general characteristics of the larch tree?

_____

_____

3. What do cedars have that the others do not? _____

_____

4. Draw the needles of a hemlock twig.

5. Which needle trees did you like the best? _____
   Why?

## Name that Tree
### *Extension Activities*

1. Pretend you are a needle tree. How were you born? What do you look like? Where is your favorite place to live? What really "bugs" you? How do you feel about humans? Who is your best friend? What is your favorite season of the year? How do you feel about Christmas?

2. Adopt a needle tree. Describe its size, shape, color, and other characteristics. What is living in it? Around it? On it? Visit your tree in the spring, summer, winter, and fall. What changes do you see?

3. Find some cones. Make a chart to match the cone with the needles of its tree. Share this information with your classmates.

4. Collect various-sized cones and create an art project.

## Computer Software Program Review and Description

**Planet Distances** **Planet Diameters**

**Ages on Planets** **Weights on Planets**

**Planet Travel**

Programs: *Planet Distances, Planet Diameters, Weights on Planets, Ages on Planets, Planet Travel*
Package: **Elementary Science Activities**
Package developers: Eileen Bengtson, Sandy Justin, Paulette Malay
Programmers: Paulette Malay, Paul Bengtson
Computers: Apple IIe, Commodore 64
Grade Levels: 3-7
Skills developed: measuring; collecting, recording, analyzing and using data

Description: The set of solar system programs is designed to give the classroom teacher a variety of topical choices for lessons. Any space (classroom, hallway, playground, etc.) can become the setting for the solar system model. Given an initial scale model dimension (diameter) for the Earth, the program enables the students to compute the proportional distances of each planet from the sun and the proportional sizes of the planets. Using this information, the students then may construct their own solar system model and experience the sensation of relative distances and sizes in our solar system Additional programs on this disk allow the students to fantasize about the solar system by calculating their weights and ages on another planet. Also, students may use the program to calculate the amount of time it would take them to reach a specific planet from Earth.

The Extensions and Activities are designed to give the student practice in obtaining and recording data. Personalization is achieved via having each student incorporate his or her own statistics into the data.

## Computer Software Activity Lesson Plan

Topic: Build a Solar System Model

Objectives: The student will be able to construct a model of the solar system in which
- planet sizes are calculated proportionately from that of Earth;
- planet distances from the sun are calculated proportionately from that of Earth.

Software needed: master disk - **Elementary Science Activities**
programs - ***Planet Diameters***
***Planet Distances***

Other materials:

meter sticks
large colored paper
scissors
tape
compasses
rulers
string (for hanging)
Data Sheets
Applications Sheet
calculators (optional)

General Description of the Activity/Procedure:

1. Measure the length of the room (in meters).
2. Decide on the diameter (in centimeters) for the scale model of Earth.
3. Run the program *Planet Distances* and record data.
4. Run the program *Planet Diameters* and record data.
5. Use the data to construct model planets and Sun.
6. Hang models (Earth, planets, Sun) in the classroom.

**Build a Solar System Model**
***Data Sheet***

1 Actual length of room: _____meters

2. Scale distance of planet models from the Sun model:

Sun= 0 meters Jupiter=_____

Mercury=_____ Saturn=_____

Venus=_____ Uranus=_____

Earth=_____ Neptune=_____

Mars=_____ Pluto=_____

3. Scale diameters of planet models:

Sun=_____ Jupiter=_____

Mercury=_____ Saturn=_____

Venus=_____ Uranus=_____

Earth=_____ Neptune=_____

Mars=_____ Pluto=_____

**Build a Solar System Model**
*Applications Worksheet*

1. List the planets in order of size beginning with the smallest.

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

   f. _____

   g. _____

   h. _____

   i. _____

2. What is the difference in size between the smallest and largest planets?

   _____

3. Which planet's average distance from the Sun is closest to the Earth's?
   _____ How close is it? _____

4. How many Earths would fit along the diameter of the Sun?_____

   How many Jupiters would fit along the diameter of the Sun? _____

   How many Plutos would fit along the diameter of the Sun?_____

5. If your room is 300 meters long, how far away from the Sun would

   Neptune be?_____ Uranus?_____ Venus? _____

## Computer Software Activity Lesson Plan

Topic: Visit to a Planet

Objectives: The student will be able to determine his/her age and weight on each planet based on the age and weight on Earth.

Software needed: master disk - **Elementary Science Activities**
programs - ***Weights on Planets***
***Ages on Planets***
***Planet Travel Times***
***Planet Diameters***
***Planet Distances***

Other materials:
Data Sheets
Application Sheets
Extension Sheets

General Description of the Activity/ Procedure:

1. Select a planet.
2. Run the program *Planet Diameters* or use the Solar System Model data.
3. Run program *Weights on Planets* and record data.
4. Run program *Ages on Planets* and record data.
5. Run program *Planet Travel Times* and record data.
6. Bonus/Extension activities ....

## Visit to a Planet
### *Data Sheet*

1. Weight on Earth=_____

Weight on:

Mercury= _____ Saturn=_____

Venus=_____ Uranus=_____

Mars=_____ Neptune=_____

Jupiter=_____ Pluto=_____

2. Age on Earth=_____

Age on: Mercury=_____ Saturn=_____

Venus=_____ Uranus=_____

Mars=_____ Neptune=_____

Jupiter=_____ Pluto=_____

3. Planet travel to/from Earth:
Imagine that the planets have stopped in their orbits, that they are all in line with the Sun (syzygy), and that a straight road connects all of them. If you could travel on that road how much time would be needed to reach these planets from Earth?

Your speed in kph (kilometers per hour)_____

Years to:

Mercury=_____ Saturn=_____

Venus=_____ Uranus=_____

Mars=_____ Neptune=_____

Jupiter=_____ Pluto=_____

**Visit to a Planet**

***Applications Worksheet***

_____'s Visit to _____

(name) (planet)

The planet which I "visited" is _____. This planet

is _____ kilometers in diameter and it is located

_____kilometers from the Sun. It is found between

_____ and _____. In order

from smallest to largest (smallest = 1; largest=9), it is _____ .

If I could live on _____ I would be

_____years old and I would weigh about _____kilograms.

If I were to leave this planet traveling at _____kph, it would take me

_____years to arrive on the Earth. (Imagine that the planets have stopped in their orbits, they are all on the same side of the Sun, and a straight road connects them.)

*** BONUS ***

The number of satellites (moons) this planet has is _____. Its

atmosphere is mainly _____. One of its interesting

characteristics is that it_____

_____

_____

## Visit to a Planet
## Extension Activities

**Language Arts--**

1. Write a paragraph describing a typical day on your planet. Be sure to tell how long the "day" is. Include some adaptations you would have to make in order to live there. Tell what you look like, how you move around, what you do for fun, etc. Draw a picture to help illustrate your appearance and your environment. Use your imagination.
2. Use library books to research things like: asteroids, number of moons for each planet, etc.
3. Research Voyager's findings to see what new information we learned from its journey.

**Art**

1. Make a 3-D model of the solar system.
2. Draw your environment.
3. Make a diorama.
4. Make a model of your best friend who also lives on your planet.

**Math**

1. Which planet is farthest from the Sun? How much farther is Uranus than Earth? Mars than Mercury? etc.
2. Which planet has the largest diameter? How much larger is Jupiter than Earth? Neptune than Pluto? etc.
3. Graph your weight and/or age on each planet.

**Science**

1. Why would you be older on Mercury than on Earth?
2. What is the surface like on your planet?
3. Why do you weigh more on Jupiter than on Earth?
4. What new information discovered by the space probe, *Voyager*, refutes your previous conceptions of the solar system?
5. What pollution problems do you have on your planet? How are you dealing with them?

**Social Studies**

1. What type of government do you have on your planet? Give details.
2. Who has the mineral rights to your planet's resources? Give details.
3. What are the laws regarding immigration to and emigration from your planet?
4. How do the inhabitants of your planet treat the planet compared to the way we treat Earth?

**Computer Software Program Review and Description**

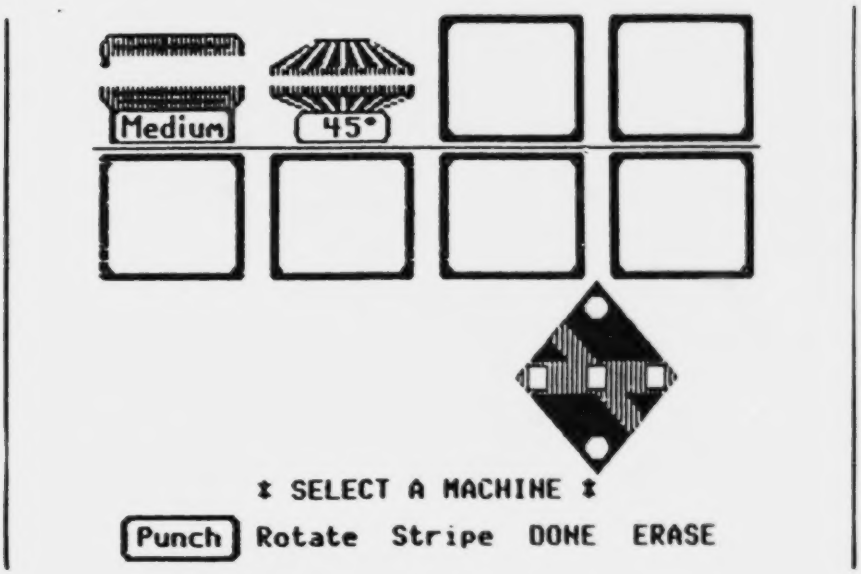
| | |
|---|---|
| Program: | **The Pond** |
| Publisher: | Sunburst Communications<br>39 Washington Ave.<br>Pleasantville, NY 10570<br>(800) 431-1934 |
| Price: | $59.00 |
| Computers: | Apple II,IIe,IIc; Commodore 64;<br>IBM PC, PC jr ; Tandy 1000; TRS 80 |
| Grade Levels: | 2 - adult |
| Skills developed: | pattern recognition, prediction, logic |

Description: The Pond is designed to teach pattern recognition, sequencing, and the use of strategy. The student develops and tests hypotheses to learn how to prevent a frog from falling into the water as it moves from lily pad to lily pad.

At the beginning of the program, the student has the option of a practice run or playing the game. The Practice option allows the student to choose from six ponds of increasing difficulty. Level 1 ponds involve 2-step problems. Level 2 ponds offer 2-step problems with distractors (extra lily pads). Level 3 ponds offer 3-step problems; Level 4, 3-step with distractors; Level 5, 4-step problems; Level 6 ponds, 4-step problems with distractors. Students must guide their frog from pad to pad by constructing a set pattern that does not allow the frog to fall into the water.

To play the game, each student is given 35 moves. As the pond is explored, or each time help is requested, moves are subtracted. When a student successfully navigates three different patterns within 35 moves, he/she then moves on to a higher level. Students can work alone to test their abilities or in groups to challenge each other. Detailed suggestions and instructions are included in the Sunburst materials.

**Computer Program Review and Description**



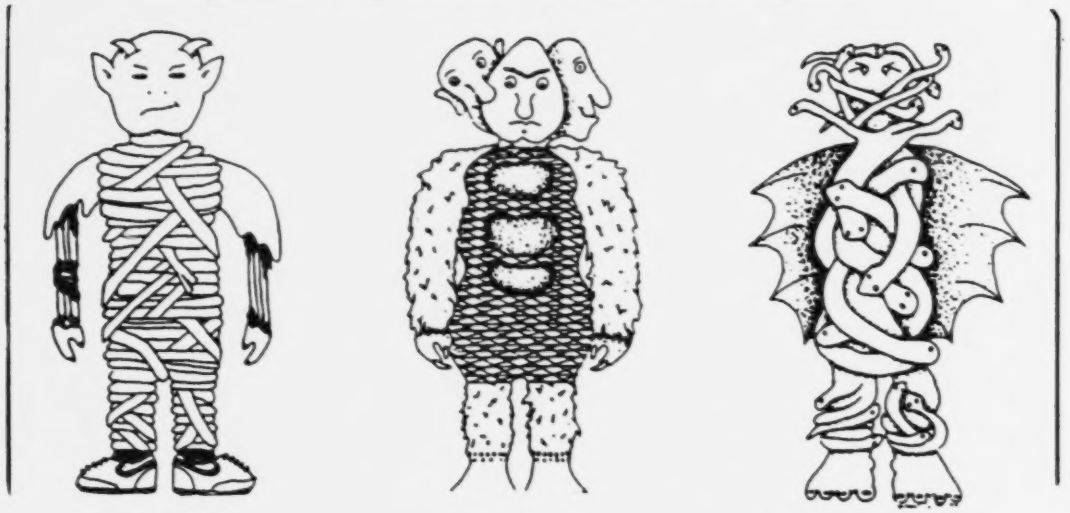

Program: **The Factory**
Publisher: Sunburst Communications
39 Washington Ave.
Pleasantville, NY 10570
(800) 431-1934
Price: $59.00
Computers: Apple II,IIe,IIc; Commodore 64;
IBM PC, PC jr.; Tandy 1000; TRS 80
Grade Levels: 3-adult
Skills developed: visual discrimination, spatial perception, analysis, synthesis

Description: This program is designed to teach strategies. The first level of the program, Test a Machine, enables the students to try each machine to see how it affects the final product.

The second level, Build a Factory, enables the students to put machines together to form a factory assembly line. Students then PREDICT what their product will look like and then can run the program to see the final product. Having designed a product via such an assembly line, the students can challenge each other to construct the same product.

In the third level, Make a Product, a product is shown and students are asked to duplicate it. There are 3 levels of difficulty - Easy, Medium, Hard. Students must use analytical skills to determine the correct progression for duplicating the product. The manual for this program offers a variety of suggestions for additional activities.

**Computer Program Review and Description**



Program: **The Incredible Laboratory**
Publisher: Sunburst Communications
39 Washington Ave.
Pleasantville, NY 10570
(800) 431-1934
Price: $59.00
Computers: Apple II,IIe,IIc; Commodore 64;
IBM PC, PC jr; Tandy 1000; TRS80
Grade Level(s): 3-adult
Skills developed: analysis, cause/effect (trial and error experimentation)

Description: The Incredible Laboratory develops problem-solving skills through a simulation of a monster-producing laboratory. The monsters produced have 5 changeable body parts: head, chest, arms, legs, and feet. The appearance of each body part is determined by a specific "chemical" -- Black Ice, Yellow Rind, and three others. Each chemical determines what a specific body part will look like -- e.g., Black Ice might produce a skull-like head whereas Yellow Rind might produce frog-like feet. The user of the program may select any or all of the chemicals to produce monsters. If specific chemicals are not chosen, the program will generate the body parts randomly. The objective is to determine which chemical creates which body part. At higher levels chemicals become synergistic and act differently in combination than they would alone.

The program develops analytical skills via trial and error, data recording and analysis, and logical thinking. The manual for this program offers a variety of suggestions for additional activities and includes several worksheets such as the one in the following lesson.

## Computer Software Activity Lesson Plan

Topic: Monster Maker

Objective: The student will be able to determine the chemical which effects each body part.

Software needed: **The Incredible Laboratory**

Additional hardware needed or desirable: color monitor desirable

Other materials: Data sheets

Procedure:

1. Explain the program to the class.
2. Begin with the easy constructions.
3. Have students work in groups to solve the problem.
4. Have students use the Data Sheet in solving the problem.
5. Encourage the students to share strategies.

**MONSTER MAKER**

**Data Sheet**

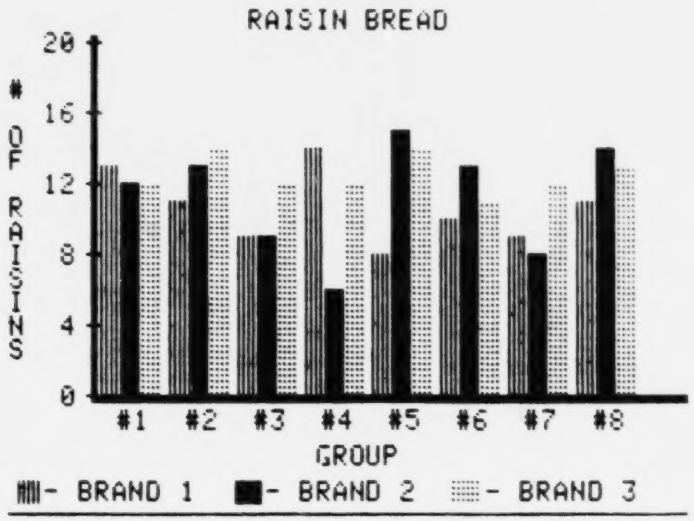
Number of monsters made=_____

As you go through the program, cross off each part as it becomes evident that a chemical did not create it.

| | | | | | |
|---|---|---|---|---|---|
| Alien Oil | head | arms | body | legs | feet |
| Black Ice | head | arms | body | legs | feet |
| Goose Grease | head | arms | body | legs | feet |
| Sparkles | head | arms | body | legs | feet |
| Yellow Rind | head | arms | body | legs | feet |

| Description | | Chemical |
|---|---|---|
| The head looks like _____ | and is created by | _____ . |
| The arms look like _____ | and are created by | _____ . |
| The body looks like _____ | and is created by | _____ . |
| The legs look like _____ | and are created by | _____ . |
| The feet look like _____ | and are created by | _____ . |

**Computer Software Program Review and Description**




Program: MECC Graph

Publisher: MECC
3490 Lexington Ave. N
St. Paul, MN 55126
(612) 481-3500

Price: In CT--Site license is available through your Regional Education Center. Purchase of a site license by a school district confers the right to make legal copies of MECC software for use in the district Price varies with the size of the district.

Computers: Apple II, IIe, IIc

Additional hardware needed: printer desirable, color monitor desirable

Grade Levels: 3-adult

Skills developed: visual discrimination and interpretation, reasoning, making inferences

Prerequisite skills/concepts: concept of graphs

Description:

This is a tool which helps the student draw a bar graph, a line graph, or a pie graph. The program walks the student through the process of labeling the graph, entering data, and labeling coordinates. When all the data is entered, the student can choose the type of graph which best illustrates the findings. All data-entry screens and graphs can be printed.

**Computer Software Activity Lesson Plan**

Topic: Raisin Bread Analysis

Objective: The students will be able to collect data and use a graphing program to see a visual representation of their findings.

Software needed: **MECC Graph** (not public domain)

Other materials:

3 loaves of raisin bread - 2 of same brand from different stores
1 different brand

Data Sheets
Extension Sheets

General description of the Activity/Procedure:

1. Pass out 1 slice of bread from **LOAF 1** to each pair of students.

2. Students count the number of raisins in their slice of bread. (Partial raisins should be combined to form whole units.)

3. Record all data on a scatter graph. Copy data onto individual Data Sheets.

4. Repeat Steps 1-3 for **LOAVES 2** and **3**.

5. Input info for **LOAF 1, LOAF 2,** and **LOAF 3** into the computer.

6. Print out bar graph generated by the program.

## Raisin Bread Analysis

### Scatter Graph of Raisin Distribution

## Raisin Bread Analysis
### *Data Sheet*

| | | LOAF 1 | LOAF 2 | LOAF 3 |
|---|---|---|---|---|
| Brand | | | | |
| GROUP NUMBER | 12 | | | |
| | 11 | | | |
| | 10 | | | |
| | 9 | | | |
| | 8 | | | |
| | 7 | | | |
| | 6 | | | |
| | 5 | | | |
| | 4 | | | |
| | 3 | | | |
| | 2 | | | |
| | 1 | | | |
| TOTAL | | | | |
| AVERAGE PER SLICE | | | | |

TOTAL RAISINS IN ALL SLICES _____

## Raisin Bread Analysis
## Extension Activities

1. You can collect data on many other subjects for graphing. Some suggestions are: favorite ice cream, athletic teams, sports, colors, subjects, candy, etc.

2. Compare the data for each slice from the different loaves of bread. Does the first slice have more or less raisins than, for instance, the fifth slice from each loaf?

3. Does this analysis show quality control in your product? If quality control is good, what should your graph look like?

4. How do bar graphs, line graphs, pie graphs differ in the way they each represent the data? How are they alike?

5. Have the students create their own graphs on paper.

6. Write a paragraph giving suggestions as to what we can do with the by-products of this raisin bread experiment.

7. Write a letter to the manufacturers explaining your project and evaluating their quality control.

**Computer Software Activity Lesson Plan**

Topic: Color distribution of m&m's

Objective: The students will be able to collect data and utilize a graphing program to see a visual representation of their findings.

Software needed: **MECC Graph** (not public domain)

Other materials:

bags of m&m's
Data Sheets
Extension Activities sheets

General description/Procedure:

1. Have students complete the Preliminary Activity sheet.
2. Pass out a bag of m&m's to each group.
3. Students count the number of m&m's of each color in their bag.
4. Record data on data sheet
5. Input data into computer graph program to generate a bar graph.
6. Print out bar graph.

**Color Distribution of m&m's**
***Preliminary Activity***

WARNING:
Do not eat your research materials until instructed to do so by your teacher.

List the colors of m&m's in a bag.

Predict the order of the colors in a bag from most to least.

most =_____
|
|
|
|
|
|
|
|
|
|
|
least=_____

Predict the total number of m&m's in your bag. _____

## Color Distribution of M&M's
### Data Sheet

| Color | Group 1 | Group 2 | Group 3 |
|---|---|---|---|
| Green | _____ | _____ | _____ |
| Yellow | _____ | _____ | _____ |
| Tan | _____ | _____ | _____ |
| Red | _____ | _____ | _____ |
| Brown | _____ | _____ | _____ |
| Orange | _____ | _____ | _____ |

## Color Distribution of M&M's
### *Extension Activities*

1. Make a scatter graph of your data.

2. Compute class totals for each color.

3. Find the class average per bag for each color.

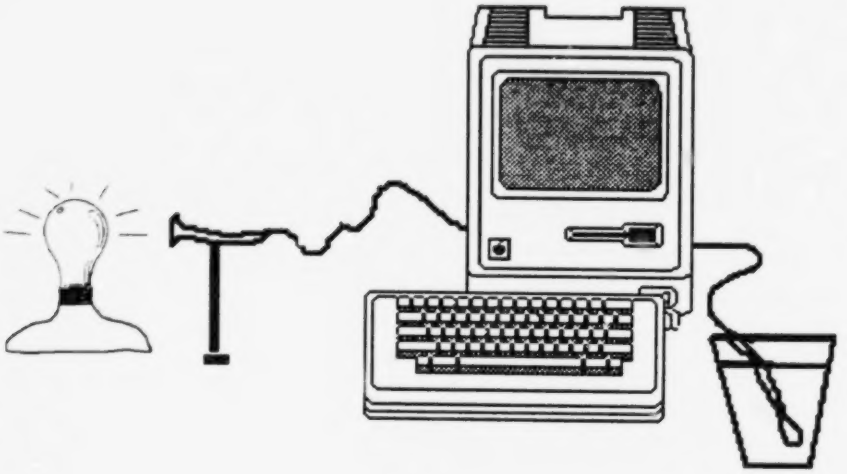
4. Make a pie graph and/or a line graph to compare and contrast how well these two types of graphs show the results.

5. Generate a graph which shows the class average as it compares to your group's number for each color.

| Color | # in your group | Class average |
|---|---|---|
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |

**Computer Software Review and Description**

# Microcomputer Based Laboratory



Software package: **Science Tool Kit** - Master Module
Publisher: Broderbund Software
P. O. Box 12947
San Rafael, California 94913-2947

Price: $69.95
Computer: Apple IIe
Grade Levels: 3-adult
Skills developed: measurement; collecting, organizing and analyzing data

Description: Microcomputer Based Laboratory (MBL) offers an oppor- tunity for the students to use actual instruments - in this case a thermistor (temperature probe which reacts to temperature changes by changing its electrical resistance) and a photocell (light probe which reacts to changes in light intensity and has a range of from 0 to 500 **foot candles**) - to measure, organize, and analyze real physical quantities. The sensing probes in turn send electrical signals to the computer where the software program inter- prets and analyzes these data and presents results in graphical or tabular form.

The sensory probes are plugged into an interface box (included in the package) which attaches to the Apple through its game port. Complete directions for using the equipment are included in the software package.

**Computer Software Activity Lesson Plan**
**MBL**

Topic: Insulating Effect of Various Materials

Objective: The student will be able to determine which of the materials are better heat insulators.

Software needed: master disk - **Science Toolkit** (or other MBL master program)
program - ***Thermistor***

Other materials:
similar containers made from different materials -
styrofoam, plastic, paper, glass, etc.
warm water
paper towels
clock with a seconds hand
graph paper
colored pencils or markers
Data Sheets

General Description of the Activity/Procedure:

1. Obtain 3 containers of the same size and shape, but made of different materials.
2. Obtain a pitcher of the warmest tap water available
3. Record the temperature of the pitcher of water.
4. Pour the water into containers.
5. Record data (time, temperature of water) on Data Sheet.
6. **Predict** what the temperature in each container will be after 8 minutes.
7. After 8 minutes, take the temperature of the water in each container.
8. Record the data.
9. Repeat Steps 6, 7, 8 **three** times.
10. Graph your results - use a different color line for each container.

## Insulating Effect of Various Materials

**Data Sheet**

Initial temperature: _____ °C

Starting time: _____ Starting time plus 8 min.: _____

| Container | Predicted temp.after 8 min. | Actual temp. at ___ | Predicted temp.8min. after last reading | Actual temp. at ___ | Predicted temp.8min. after last reading | Actual temp. at ___ |
|---|---|---|---|---|---|---|
| _____ | _____°C | _____°C | _____°C | _____°C | _____°C | _____°C |
| _____ | _____°C | _____°C | _____°C | _____°C | _____°C | _____°C |
| _____ | _____°C | _____°C | _____°C | _____°C | _____°C | _____°C |

**Computer Software Activity Lesson Plan**
**MBL**

Topic: Effect of Surface Area on Heat Loss

Objective: The student will be able to determine the effect of surface area on the insulating quality of various materials

Software needed: master disk - **Science Tool Kit** (or other MBL master program)
program - ***Thermistor***

Other materials:

various-shaped containers of the same material - for example, a styrofoam bowl, cup, plate
warm water
paper towels
clock with second hand
graph paper
colored pencils or markers
Data Sheets

General Description of Activity/Procedure:

1. Obtain 3 containers of various sizes but of the same material.
2. Obtain pitcher of warmest tap water available
3. Record the temperature of the pitcher of water.
4. Pour approximately equal amounts of water into each container.
5. Record data (time, temperature of water) on Data Sheet.
6. **Predict** what the temperature in each container will be after 8 minutes.
7. After 8 minutes take the temperature of the water in each container.
8. Record the data.
9. Repeat Steps 6, 7, 8 **three** times.
10. Graph your results - use a different color line for each container.

## Effect of Surface Area on Heat Loss
### Data Sheet

Initial temperature: _____ °C

Starting time: _____ Starting time plus 8 min.: _____

| Container | Predicted temp.after 8 min. | Actual temp. at ____ | Predicted temp. 8min. after last reading | Actual temp. at _____ | Predicted temp.8min. after last reading | Actual temp. at ___ |
|---|---|---|---|---|---|---|
| _____ | _____°C | _____°C | _____°C | _____°C | _____°C | ____°C |
| _____ | _____°C | _____°C | _____°C | _____°C | _____°C | ____°C |
| _____ | _____°C | _____°C | _____°C | _____°C | _____°C | ____°C |

**Computer Software Activity Lesson Plan**
**MBL**

Topic: Measuring Light Intensity at Different Distances

Objective: The student will be able to determine the effect of distance from the source on the intensity of light.

Software needed: master disk - **Science Tool Kit** (or other MBL master program)
program - ***Light Sensor***

Other materials:

light source: a lamp with low-wattage bulb (max. 40 w.)
or flashlight
measuring tape or graph paper
photocell light guard (optional)
photocell stand (optional)
calculators (optional)
Data Sheets

General description of the Activity/Procedure:

1. Explain meaning of *foot candle*.
2. Darken room.
3. Set light source 5 cm from light sensor.
4. Record *foot candle* reading on Data Sheet.
5. Set light source 10 cm from light sensor.
6. Record reading on Data Sheet.
7. Give the amount of light at 10 cm. as a percent of that at 5 cm.
8. Continue to set the light source at the indicated distances. Record the data. Then find the light intensity at each station as a percent of that measured at 5 cm.
9. Graph your results (light intensity vs. distance from source).

## Measuring Light Intensity at Different Distances
### Data Sheet

| Distance (cm) | Light intensity (*lx*) | Intensity as % of last reading |
|---|---|---|
| 5 | a)_____ | 100% |
| 10 | b)_____ | (b/a)_____% |
| 20 | c)_____ | (c/b)_____% |
| 40 | d)_____ | (d/c)_____% |
| 80 | e)_____ | (e/d)_____% |

You might have expected that as the distance away from the light sensor doubled, the light intensity would be one-half (50%) of the previous reading; however, using high school math we can show that light intensity drops off according to the Inverse Squares Law -- *i.e.*, as distance doubles, intensity drops to one-fourth (25%) of the previous value.

## Measuring Light Intensity at Different Distances
### Extension Activities

1. Find the class average for the light intensity measured at each station.

2. Make graphs to illustrate the light intensity at each station

    a) using your data.

    b) using the data from the class averages.

3. Use your graphs. What appears to happen to the light intensity each time the distance from the source is doubled?

4. Give the intensity as a % of the first reading (at 5 cm ) for each of the other readings. Show these results via a graph. What surprises you about the appearance of the graph?

5. Look up the Inverse Squares Law in a high school physics book or in an encyclopedia. To what else does it apply besides light?

pimms

## Elementary Science Activities

### A pimms COMPUTER SOFTWARE AWARENESS WORKSHOP

Place: Date:
Time:

Target Audience: Elementary school teachers, principals, curriculum directors

Maximum enrollment: 30

Presenters:

Eileen G. Bengtson - computer specialist, science coordinator, Hurlbutt Elementary School, Weston
Paulette Haley - teacher of computer, science, math, Staples Elementary School, Easton
Sandra Justin - teacher of science, math, Hemingway Park School, Watertown

Description:

Computer technology is having a great impact upon education. The rapid generation of images by computers can be invoked to help convey concepts visually (and quickly) and thereby provide more classroom time for analysis and conjecture-testing. In this workshop we relate computers to science and thinking skills (grades 3-7) using Teacher Developed Software, Commercial Software, and MBL (microcomputer-based laboratory) equipment in a hands-on environment. The software demonstrated runs on Apple and/or Commodore computers.

Workshop participants may bring a disk to obtain a copy of the teacher-developed software, **Elementary Science Activities**.

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

Schools may configure a workshop to their needs by making selections from the following list. Approximate time allotments are given to guide your choices. Desirable hardware for the workshop: 1 computer per 4 participants, one printer, at least one color monitor. Requests for Workshop presentations may be made directly to the presenters or via the **pimms** Science Coordinator (see Foreword).

Teacher-Developed Software (**Elementary Science Activities**):
- **Rock Identification Key**- Rock Identification (20-30 min.)
- **Needle Tree Key** - Needle Tree Identification (20-30 min.)
- **Solar System** (overview, 45 min.; 2 activities in depth, 90 min.)

Commercial Software:
- **The Factory** (30 min.)
- **The Pond** (30 min.)
- **The Incredible Laboratory** (35 min.)
- **MECC Graph**
  - Raisin Bread Analysis (45 min.)
  - Color Distribution of M&M's (30 min.)

**Science Tool Kit** (Microcomputer Based Laboratory):
- Insulating Effect of Various Materials (45 min.)
- Effect of Surface Area on Heat Loss (45 min.)
- Measuring Light Intensity at Different Distances (30 min.)

**pimms** Curriculum Development Publications

* Apple Microcomputer Software Evaluation, August 1985; 14 pp. (free)

* A Review of Selected Microcomputer Software Packages with Lessons for Teaching Mathematics, Grades 8 - 12, Vol. 1, April 1987; 122 pp. $4.50

* A Review of Selected Microcomputer Software Packages with Lessons for Teaching Mathematics, Grades 8 - 12, Vol. 2, **April 1988**; 170 pp. $6
[Also available on a single 5.25" disk (AppleWorks IIe,IIGS), $6]

* A Guide to Curriculum Development in Applied Mathematics: A Three-year Sequence for Non-College-Bound Students (Vol. 1 of 3, preliminary edition), Fall 1986; 82 pp. $3.25

* Down to Earth Chemistry, (for the non-college-bound), 3 sample units, February 1987; 60 pp. (free)

* Down to Earth Chemistry, (for the non-college-bound), **April 1988**; 337 pp. $10
[Also available on a 4-volume set of 5.25" disks (Applewriter), $10]

* A Guide to Computer Use by the Science Teacher, October 1987 c.; 70 pp. $3
[Also available on a single 5.25" disk (Applewriter), $3]

* Microcomputer Activities for the Teaching of Science and Thinking Skills in the Elementary School, Grades 3 - 7, **April 1988**; 42 pp. $3
[Also available on a single 3.5" disk (MacWrite 4.5), $3]